GEOMODELING TO OPTMIZE WELL DESIGNS IN THE MONTNEY

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Summary

Subsurface teams developing unconventional resource assets must demonstrate the benefits of switching to a new completion design to their shareholders. The new design must determine optimal reserve recovery with cost efficiency. Harvest and FRACMOD developed a geomodel, a hydraulic fracture model coupled with reservoir simulation to find an optimal 'Plug and Perf' solution for the Montney before any field execution occurred. The reservoir models were used to predict the production profiles for the child well in light of depletion due to the parent well.

Workflow

A geomodel over the project area was cut out of the Montney Oil Cube^{TM} and high graded with proprietary data from Harvest. The static model incorporated over 700 Montney penetrations with well surveys, tops, core, production, and hydraulic fracture stimulation data. The petrophysical model and the foundation of the geomodel were based on a review of 121 petrophysical logs and 13 Montney cores (1 CMS and 1 Dean Stark). The petrophysical model parameters calculated include porosity, Vshale, Sw and Perm using a statistical approach to model mineralogy based on XRD measurements from core.

The geo-model provided input to fracture and simulation models to optimize Harvest's completion design. Fine grid models were exported from the geomodel built in Petrel to GOHFER for the frac modeling, and to GEM/Navigator for reservoir simulation. In parallel, Peng Robison EOS models were built, tuned to laboratory, and verified by history matching multiple Montney wells in the area in a reservoir simulation model using template-based frac models. Several completion options were simulated to select the most optimal design. Sensitivities were run on geomechanical and reservoir parameters that impact fracture height, stimulated rock volume, and fracture width. The model was used to optimize landing depth, injection rate, proppant loading and cluster design. The GOHFER model sensitivity analysis was coupled with a flow simulation model to generate production profiles for the well. This model was run for multiple iterations of different cluster designs, proppant, and fluid loading to determine the optimal design.

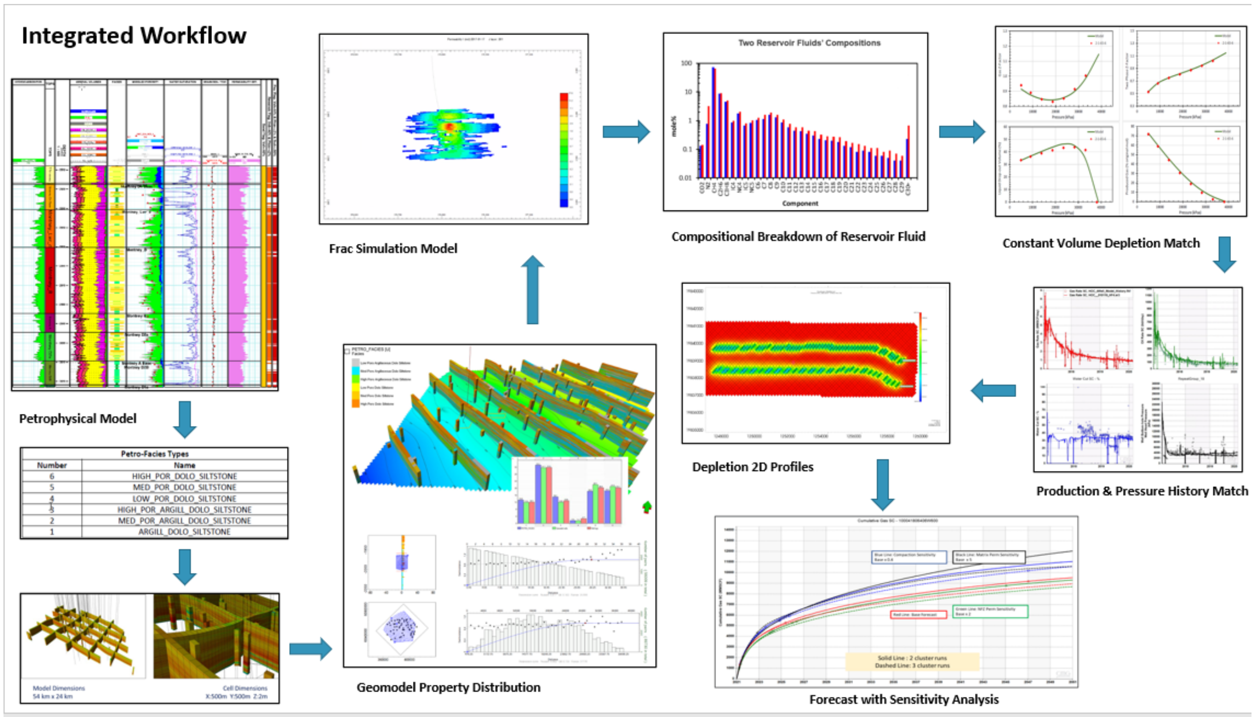
Harvest used the coupled geomodel and the simulation for a parent/child study. The purpose of this study was to simulate depletion of the parent well over time by varying the timing of the child on production after the parent well. The cumulative production from the parent well prior to drilling the child well and the inter-well spacing between parent and child wells was analyzed to understand the impact on the parent and child well production profiles.

Production profiles were generated for a horizontal well with multiple completion designs, then an economic model was run to quantify performance metrics for the proposed completion design. Sensitivity analysis was also carried out on the impact of compaction on the fracture and matrix permeability.

Results, Observations, Conclusions

A sensitivity analysis was carried out by varying geological/geomechanical and frac design parameters. This was done to observe the magnitude of impact each parameter had on production rate and frac geometry. Sensitivity to injection volumes, rates, proppant tonnage and on fracture flowing area and production profiles were generated. Using this data, optimal design parameters were selected that maximized the flowing area.

Four fracture design cases were simulated to study the impacted flowing area for each design. From these four designs, the two-cluster design resulted in a high EUR, whereas the three-cluster design provided incremental production over the early life of the well; however, the incremental production was minimal early on. The two-cluster design had a higher EUR as was predicted by the parameterized model. The final design parameters for stage spacing, proppant loading, fluid loading and cluster design were recommended to Harvest.



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